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(54) **Water jet edge trimming station for use in papermaking machine**

Wasserstrahleinrichtung zum Besäumen der Längskanten zur Verwendung in einer Papiermaschine

Dispositif à jet d'eau pour le rognage des reives longitudinales pour usage dans une machine de fabrication du papier

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## Description

### Field of the Invention

[0001] The present invention is directed to a water jet edge trimming apparatus for trimming the edge from a moving web in a papermaking machine. More specifically, the present invention is directed to a water jet edge trimmer system for trimming coated paper.

### Background of the Invention

[0002] In the papermaking industry certain applications require edge trimming of the paper web during web travel in the papermaking machine. One such application occurs in the manufacture of coated paper. Coating can be done "on-machine" or "off-machine". Coating on-machine means that the paper is made in the normal fashion and an additional coating station is provided such that the paper is coated as it travels in the papermaking process.

[0003] During the coating process the "raw stock" paper is coated across the width of the web except for the edges of the paper where a trim of approx. 7,6 to 12,7 mm (0.5 to 3 inches) of the paper web is not coated. Both sides of the paper web may be coated with plastic or paint products which can make up a significant part of the paper weight. The uncoated edges must be trimmed off before processing the paper further, such processing involving calendering or supercalendering, for example. This trimming step is typically done by means of a mating pair of rotary slitting knives. Slitting knives, or "slitters" are used to trim paper edges after the coating station thereby removing uncoated edges of the paper from the traveling web. Slitters are also employed upstream of the coating station to cut the paper web prior to coating preventing cracked edges from entering the coater because coating of cracked edges leads to further complications.

[0004] There are disadvantages associated with the use of knives. Knives require high maintenance due to abrasive wear of the coating filler material, i.e. calcium carbonate or titanium dioxide. Further, slitter knives have a tendency to separate (jamming) when flying splices of overlapping paper sections joined together by tape having triple the basis weight pass by the knife slitters. Jamming leads to paper breaks. Also, slitter knives are very sensitive to paper wrinkles that enter the slitting zone resulting in edge tearing of the paper. Further, it is very difficult to enter the running paper web into the paired slitter knives without crimping the edge which can lead to web breaking.

[0005] For the above stated reasons, it is standard practice in the paper making industry to avoid cutting the trim on the on-machine coater, because one paper break may cost up to $8000 in lost production time. To avoid the potential hazards associated with on-machine trimming, trimming is usually done off-machine on a rereeler machine which is a separate machine used to unreel, edge trim and re-reel the paper web. Such a rereeler operation requires significant labour costs to operate in addition to the capital costs of purchasing such a machine. Clearly, on-machine trimming of the edge of the paper web during the coating section of the machine would be the preferred choice of manufacture if the risks associated with web breakage by edge trimming after the coating station could be avoided or reduced.

[0006] If a water jet could be used to trim the edge of the coated paper, then the disadvantages associated with the use of rotary knives in the on-machine edge trimming would be avoided. The pressure of the water jet is sufficient to cut through flying splices of triple basis weight on the coated paper. Further, changes in tension which can cause paper wrinkling have no apparent effect on the water jet cutting ability to provide a clean cut without tearing.

[0007] While it is known to use water jets to cut a paper web, the general teaching in the art is to cut the web with the water jet impinging the web surface in a direction normal to the web surface to maximize the cutting efficiency of the waterjet. However, when this teaching was applied by the applicant to coated paper webs, some disturbing problems were experienced which adversely affected the cutting performance of the water jet.

[0008] One problem experienced with using such a normal directed water jet to effect trimming of the coated paper is backsplash. It should be understood that the water jet pressure and nozzle orifice can be chosen such that the water jet impinges the paper web at speeds in excess of 2000 feet/second or about 615 meters/second. The energy of this impact transforms the fluid into a gaseous state. This represents expansion in volume in the order of 1250 times. Consequently the gas stream formed by the water jet impinging the web results in a cloud of fumes when the paper is of sufficient weight and thickness to backsplash minute portions of the water jet spray. The fumes and atomized paper particles backsplash towards the nozzle head of the water jet. The coating mass on the paper which contains calcium carbonate is splashed from the cutting surface back to the nozzle head and is also sprayed on other parts of the paper. During use, the fine particles of calcium lump together to form and build up extending down from the nozzle to the surface of the paper in a gummy "stalacite" type of deposit. Eventually this "stalactite" type of deposit breaks off in a lump and travels on the boundary layer of the good paper web to the wind up station where the lumped particles are glued to the next layer of paper. Upon un-winding, the glued together layers are ripped at the edge leading to complete web breaks across the paper web. Clearly, this will result in down time to re-splice and feed the tail of the paper web through the machine. Furthermore, splattering of the calcium deposits on the boundary edge of the coated paper deteriorates paper quality.

[0009] The use of water jets to perform slitting, tail cut-

ting and trimming has been disclosed in the patent literature, but there is no disclosure as to how to use the water jets to cut an "unfriendly" paper web such as coated paper during on-machine operation. For example, U. S. patent 3,996,825 issued December 14, 1976 to Rupert Terry discloses a water jet cutter for cutting and trimming a web. A first water jet impinges the web from below the web at a normal angle of 90° to the plane of the web. A second water jet impinges the web from above the web at the same point as the lower water jet impinges the web. The upper or second water jet is angled relative to the vertical axis or axis normal to the plane of the web to direct the second water jet towards the outside edge of the paper web such that the water jet forces the cut web edge away from the existing web to the outside of the cutting station. The patent teaches that various angles relative to the vertical can be used by the second water jet as long as the jet is emitted directly downwardly and toward the outside edge. A suitable angle is typically about 45 degrees. Such a trimmer would not work in cutting coated paper because splashing from each water jet onto the other water jet is subject to the problems associated with the above noted trimming of coated paper on-machine.

**[0010]** U.S. patent 5,068,513 issued November 26, 1991 to Donald Gangemi teaches a water jet cutter that is used with a laser as a slitter. In one embodiment, the water jet cutter is angled rearwardly or upstream with respect to the direction of web travel. However, the patent teaches that the relative orientation of the water jet nozzle and the laser is not deemed to be of critical importance so long as the water jet nozzle and the laser are focused at the same general spot on the traveling web. Also, DE patent application 4,218,272 laid open October 29, 1992 in the name of J.M. Voith GmbH discloses the use of either rotary cutters, water jets or lasers to cut a tail in a paper by angling the resultant cut with a vector component in opposing direction to the direction of web travel and in a second direction into the center of the web away from the edge of the web. Again these patents are not concerned with backsplash and would be subject to waste deposit build upon the nozzle heads and laser heads.

**[0011]** Document: WO-A-97-11814, which is regarded to describe the closest prior art, discloses a water jet edge trimming station for trimming an edge of a traveling paper web in a papermaking machine, comprising a water jet apparatus supported above said web for directing a water jet towards a point of impingement against said web to cut through said web and form an edge trim piece separate from said web. The water jet forming effluent by-products as it cuts the web. A support table positioned below the water jet and over which at least an edge portion of the web travels. The support table includes a cutting station having a cutting surface made of or coated with a strong material for withstanding cutting and wear associated with the paper striking the cutting surface. The cutting station includes a water jet receiving aperture extending from the cutting surface through the cutting station and positioned directly below the point of impingement of the water jet through which passes the water jet after cutting through the web. An apparatus directs a forceable blast between the web and cutting surface for creating a negative pressure directed forward and to the edge of the cutting surface to compensate for braking forces of the water jet and adapted to suck dusts and water mist off the cutting point. A trim removal chute is provided for guiding the edge trim piece away form the web. The trim removal chute also receives the effluents.

**[0012]** While prior art water jet cutters for use in tail cutting, slitting and to a lesser extent trimming are known in the paper making industry, none of these patents addresses the problems associated with backsplash and the effects of backsplash on clotting the nozzle and effecting paper quality as a result of cutting through coated paper on-machine. There is a need for a water jet edge trimming system which is not subject to the disadvantages associated with the knife edge trimmers of the prior art.

## SUMMARY OF THE INVENTION

**[0013]** The present invention, which is defined by claim 1, is directed to a water jet cutting apparatus that is not subject to the problems associated with backsplash while trimming the edges of paper on-machine. While the present invention finds particular advantage in cutting coated paper on-machine, aspects of the present invention may find application in cutting and trimming other grades of paper web including webs of considerably less basis weight such as tissue paper where rewetting and redepositing of fines during trimming can cause deposit problems.

**[0014]** In accordance with the present invention a water jet edge trimming station is provided for trimming the edge of a travelling web in a papermaking machine. The edge trimming station has a first novel characterizing feature by the manner in which effluent by-products associated with cutting the web are drawn below the cutting surface of the web to reduce backsplash and the manner in which a cutting station is constructed to withstand wear associated with paper striking the cutting station.

**[0015]** In accordance with a second novel characterizing feature of the present invention the water jet used to cut the paper is angled relative to the direction of paper web travel and the outside edge of the paper web travel. By angling of the water jet relative to the direction of paper web travel, and in particular the downstream direction, it is meant that the water jet may face downstream in the direction of web travel and the waterjet cuts at an impact angle which in theory is the same as the exiting angle, but in practice the exiting angle is slightly less than impact angle when the jet is facing downstream due to the downstream speed of the

traveling web. The relative angling of the water jet is done with respect to a the vertical or normal axis passing through a plane of the web and the side edge of the web to reduce backsplash of effluent by-products onto the water jet nozzle.

**[0016]** In accordance with an embodiment of the present invention the construction of the water jet cutting apparatus of the present invention has positive air pressure chamber surrounding the nozzle head of the water jet to maintain air flow over the nozzle head acting to drive away effluent deposits adversely affecting nozzle head performance.

**[0017]** By using a negative pressure or vacuum to draw effluent by-products through the effluent receiving vacuum assisted aperture in the cutting station, the effluent by-products can be removed from the papermaking machine. Backsplash onto the traveling web and nozzle head is diminished resulting in improved continued water jet cutting performance and paper quality.

**[0018]** The hardened cutting surface preferably comprises a ceramic shoe mounted raised above the support table by about 1 to 4 mm. The effluent receiving aperture is located in the ceramic shoe. By raising the ceramic shoe or platform above the remainder of the cutting station, then only the ceramic shoe is exposed to wear. The use of a ceramic shoe improves longevity of the cutting station. Any suitable material can be used that can withstand the wear and cutting associated with the paper striking this surface and in particular over the vacuum assisted aperture. In the preferred embodiment, there is a cut out section on the bottom surface of the ceramic shoe adjacent the effluent receiving. The purpose of using a cut out section is to reduce the depth of the effluent receiving aperture and land area in the aperture struck by the water jet and paper so as to prevent buildup of effluents in the downstream land area of the aperture.

**[0019]** The negative pressure apparatus of the cutting station preferably includes a draft tube extending from the effluent receiving aperture into the cutting station. The cutting station includes a chamber into which the draft tube partially extends to define an outer passage surrounding the draft tube. The chamber includes a water inlet and an air inlet adjacent the hardened cutting surface which permit the introduction of water and air into the outer passage surrounding the draft tube and extending into the cutting station. The cutting station further includes a mixing zone located below the draft tube and the outer passage for mixing the air and water from the outer passage and effluent by-products from the draft tube.

**[0020]** It is envisaged that the effluent receiving aperture is located a predetermined distance upstream of a downstream end of the cutting station so as to prevent buildup of effluent by-products on the hardened surface of the cutting station downstream of the effluent receiving aperture. By maintaining this distance relatively short, any effluent by-products that are not exhausted through the effluent receiving aperture have a relatively short area to buildup gummy deposits which could adhere to the hardened surface of the cutting station. In accordance with the present invention the predetermined distance is in the range of 5 to 50 mm and preferably about 40 mm.

**[0021]** In the preferred embodiment, the support table, on which the raised cutting station is mounted includes two platforms. A first raised platform extends from the cutting station downstream for supporting the traveling web. A second platform stepped down relative to, or lower than, the first platform also extends from the cutting station downstream for supporting the edge trim piece separated from the web. By having the second platform positioned below the first raised platform, separation of the edge trim piece from the continuing traveling web is facilitated. Furthermore, in the preferred embodiment, an elongated slotted aperture is provided between the first and second platforms. The purpose of a slotted aperture is to provide an unsupported section in the web travel for the wet edges of the continuing traveling web and the traveling edge trim piece. It is believed that the open elongated slotted aperture allows the unsupported edges to dry and any effluent by-product carried by the wet edges does not find a surface against which effluent by-products can buildup ultimately effecting paper quality and the trimming function.

**[0022]** In accordance with a preferred aspect of the present invention, the trim chute is attached to the support table. It should be understood that in an alternative embodiment, the trim chute may be located further downstream separated from the support table. In such an embodiment, it is possible to separate the edge trim piece by means of air jets which also act to guide the edge trim piece to the destination trim chute.

**[0023]** In accordance with an embodiment of the present invention there is provided a water jet edge trimming station for trimming an edge of a web in a paper machine where the web traveling past the station is relatively flat defining a web plane. The water jet edge trimming station includes a water jet apparatus having a nozzle supported in spaced relation from the web plane for emitting a water jet along a water jet axis towards a point of impingement against the web to cut through the web and form an edge trim piece separate from the web. The water jet forms effluent by-products as the water jet cuts the web. The embodiment is characterized by said water jet axis having a first orientation offset by a first predetermined angle relative to a normal axis extending at a right angle out of the web plane from the point of impingement such that the first orientation of the water jet directs the waterjet in a first direction relative to web surface travel to reduce backsplash of effluent by-products onto the nozzle. The water jet axis has a second orientation rotated by a second predetermined angle about the normal axis from a line extending parallel to the direction of web travel passing through the point of impingement, whereby the water jet is directed towards

the edge trim piece causing effluent by-products to move towards the edge trim piece and away from the web to reduce backsplash onto the nozzle and the web.

**[0024]** The first predetermined angle may be in the range of 15° to 45° and is preferably about 22° from the vertical.

**[0025]** The second predetermined angle may be in the range of 5° to 135°. The preferred range for the second predetermined angle is in the range of 5° to 89° and the water jet is directed generally in a downstream direction. The preferred second predetermined angle is about 30°. Alternatively, the range of the second predetermined angle is between 91° to 135° and the water jet is directed in an upstream direction. When directed in an upstream direction, the first predetermined angle is to be chosen to cause the effluent by-products to move laterally towards the edge of the web without being blown back by boundary layer windage associated with the traveling web.

**[0026]** It is further contemplated to position the nozzle of the water jet within a predetermined distance from the traveling web to maintain a laminar jet of water to cut the web. Preferably, this distance is about 12 mm from the web.

**[0027]** It is also contemplated to include in the water jet station an auxiliary air nozzle positioned immediately upstream and laterally from the water jet for directing an air stream down on an edge of the traveling web to move the edge trim piece away from the traveling web and to further direct effluent by-products away from the traveling web.

**[0028]** In accordance with an embodiment of the present invention there is provided a water jet apparatus for use in an edge trimming station for trimming an edge trim piece from a traveling web in a papermaking machine which produces effluent by-products during trimming. The water jet includes a water jet nozzle head having a water inlet tube and a nozzle having an outlet orifice through which a water jet is emitted. The embodiment is characterized by an enlarged nozzle head housing being attached to the water jet nozzle head to define a chamber surrounding at least a portion of the water jet nozzle head. The enlarged nozzle head housing has a front surface spaced from and surrounding the nozzle to define an air outlet passage around the nozzle. The enlarged nozzle head housing includes an air inlet through which pressurized air enters the chamber and flows towards and out of the air outlet passage to counteract backsplash of the effluent by-products.

**[0029]** The enlarged nozzle head housing is preferably curved to guide the traveling web under the front surface to the water jet emitted from the outlet orifice. Additionally, an auxiliary air nozzle can extend around the outer surface of the front surface to direct an air stream across the web to the outside of the web direct effluent by-products away from the nozzle head and traveling web towards the edge trimmed. Preferably, the outlet orifice extends forward of the front surface of the enlarged nozzle head housing.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0030]** For a better understanding of the present invention reference may be had to the accompanying diagrammatic drawings in which:

Figure 1 is a side-elevation view of a portion of a coating section in a paper making machine showing the positioning of the trimming station downstream from the coating station;

Figure 2 is a plan view of the traveling web of paper showing the relative positioning of the water jet and cutting table to the traveling web;

Figure 3 is a side sectional view taken along section line III-III in Figure 2, which section line extends along a line rotated about the normal axis and is bent at the point of impingement to extend along the cut edge of the paper, showing the cutting action of the water jet and the relative positioning of the cutting table below the surface of the web;

Figure 4 is a three dimensional illustrative view of the water jet axis relative to the point of impingement on the paper web; and,

Figure 5 is an enlarged view of the cutting station and support table as shown in Figure 3.

## DETAILED DESCRIPTION OF EMBODIMENTS

**[0031]** Referring to Figure 1 there is shown a coating section 10 of a paper making machine. A water jet edge trimming station or apparatus is shown generally at 12. It should be understood that the coating process occurs upstream of the trimming station 12. While the preferred application for the present invention is in the coating section of a paper making machine, the water jet trimming station 12 may be located in any portion of a papermaking machine that requires edge trimming. Furthermore, the present invention lends itself to applications where pronounced or large amounts of backsplash occur due to the water jet cutting through heavier grades of paper and/or coated paper.

**[0032]** In Figure 1 the web or paper web 14 is shown passing through water jet trimming station 12. Typically, web 14 is threaded first by rope(s) 16. To permit access to the web 14 at the edge trimming station 12, a separator sheave 18 lifts the rope(s) 16 from the web 14 at first sheave 20. The ropes 16 pass over roller 22 and again meet the web 14.

**[0033]** The trimming station 12 is supported on a base 21 and a movable carriage 26. The movable carriage 26 moves back and forth in a direction across the width of the web 14 to allow an initial edge cut into the web 14 and subsequent slitting or edge trimming of the web 14. Carriage 26 carries the support table 78 for the cutting station 13.

**[0034]** Above the web 14, the trimming station 12 in-

cludes a water jet cutter 28 having a mushroom shaped head 30. The water jet cutter 28 is supported above the web by an arm 38 connected to the carriage 26. An operator guard 32 is provided for safety covering the water jet 48. The water jet 48 is fed water from conduit 7. Conduit 7 is connected to a controlled valve generally shown at 36.

**[0035]** In accordance with one embodiment of the present invention the angulation of the water jet axis 48 to reduce backsplash is now described. While Figures 3 and 5 show the water jet axis 48 being oriented by a first predetermined angle 62 and Figure 2 shows the water jet axis 48 being oriented by a second predetermined angle 58, Figure 3 is the best illustration showing the means for obtaining the first, and in Figure 2, for the second predetermined angles and Figure 4 is the best illustration to describe the orientation of the water jet axis 48.

**[0036]** In Figure 3, the water jet cutter 28 includes a water jet nozzle body 33 through which the conduit or water inlet 7 is connected. At the other end of water jet nozzle body 33 is connected a jet nozzle retaining nut 45. The jet nozzle retaining nut 45 has an outlet orifice 46 through which a laminar water jet is emitted along water jet axis 48. The means for obtaining the angle orientation of water jet axis comprises angular bracket 40 surrounding the nozzle body 33 and connected by adjustment screw 42 to pin 44. Pin 44 is pivotally connected to carry support plate 38 to carriage support plate 36 of the trimming station 12. The pivot axis 44 allows adjustment of water jet axis 48 by the second predetermined angle. The pivot screw 42 allows the water jet cutter 28 to be secured in place at the first predetermined angle and also adjustable sideways by slot 200.

**[0037]** Referring to Figures 2 to 5, and particularly Figure 4, the orientation of the water jet axis 48 is described relative to the first and second predetermined angles 62 and 58, respectively. The direction of web 14 travel is shown generally by arrow 50. The cross-direction of carriage travel is shown by arrow 49. The arrows 49 and 50 define a relatively flat web plane passing by the trimming station. The water jet axis 48 is directed at web 14 and cuts through web 14 at point of impingement 52. As the water jet cuts through the web it produces an edge trim piece 54 that is separated from the remainder of the web 14 continuing on its downstream travel of arrow 50. The edge trim piece 54 moves past trimming station 12 and into trim chute 56. The trim chute 56 is attached to the side of trimming station 12.

**[0038]** The orientation of the water jet axis 48 is shown angled by first predetermined angle 62 relative to normal axis 61. Normal axis 61 is defined as a line extending at a right angle out of the web plane through point of impingement 52. This normal axis may be referred to as a vertical axis when the web plane is running horizontally past the trimming station 12. In the preferred embodiment of Figure 4, the first predetermined angle 62 is shown to be about 22°. This angle may vary between 5° and 45°. In Figure 4 a broken line 57 extends parallel to the web travel 50 and edge of the web 55 upstream of the point of impingement 52. Broken line 57 is shown to pass through point of impingement 52 and lie on the web plane. The second predetermined angle 58 is shown to be rotated about normal axis 61 from line 57. The second predetermined angle may lie in the range of 5° to 135° and in the preferred embodiment shown is about 30°. This results in a generally downstream and cross-stream direction of angulation of water jet 48. For illustrative purposes, the angular rotation of water jet axis 48 about normal axis 61 on the web plane is shown by broken line 59. Also, for illustrative purposes broken line 63 extending parallel to axis 61 is shown.

**[0039]** By so orienting the water jet axis 48, backsplash associated with the water jet splashing back onto the water jet nozzle and web 14 continuing to travel along arrow 50 is reduced. Further, the fog 60 (Figure 3) formed by effluent by-products of minute particles of paper and water during cutting are directed away from the nozzle 45 towards the edge trim piece 54, and trim evacuation chute 56.

**[0040]** Another embodiment of the present invention relates to the construction of water jet cutter 28 as best shown in Figure 3. In particular to protect the nozzle retaining nut or head 45 and orifice 46 from buildup of stalactite, the water jet is provided with a mushroom shaped head or cap shown generally at 64. The mushroom head 64 forms part of an enlarged nozzle head housing 66 attached with a base plate or flange 68 to the water jet nozzle body 33. Forward of the base plate 68 is provided the mushroom front surface 64. The curved surface 64 has an annular aperture spaced from the nozzle head 45 defining an air outlet passage 70. The base plate 68 and mushroom shaped front surface cover 64 together form a chamber 72. Pressurized air is communicated into chamber 72 through air inlet tubing 74. The pressurized air entering chamber 72 exits the chamber 72 at air outlet passage 70 around the nozzle head 45 causing a positive air flow pressure away from the outlet orifice 46 of the water jet 48. This positive air flow pushes potential effluent by-products away from the waterjet orifice 46 and nozzle head 45. Also located upstream and laterally of the water jet apparatus 28 is an additional air nozzle 75 (Figure 2). Air nozzle 75 is connected to air supply 34 to blow additional air beside or across the cutting point of impingement 52 to move fog 60 downstream and away from the stream from the water jet orifice 46. Further, nozzle 75 directs the edge trim 54 immediately following the cut at the point of impingement 52 into the trim chute 56.

**[0041]** The waterjet 48 maintains a laminar flow to cut through the paper web 14. In particular, when a flying splice passes beneath the water jet cutting apparatus, this portion of the web may have three times the basis weight of the web 14 normally passing beneath the cutting jet. To ensure that a cut is maintained, the nozzle head of the water jet 48 is maintained at the predetermined distance above the web 14 to maintain the lami-

nar flow of the water jet. In accordance with the present invention, the outlet orifice 45 of the water jet cutter 28 is maintained about 12 mm from the web surface. As this is not a large distance and the effects of backsplash would result in limited operation of the water jet cutter 28 prior to cleaning if it were not for the features taught by the present invention. Furthermore, within the operating environment of the water jet trimmer, the nozzle orifice has a diameter in the range of 0.07 to 0.153 mm. Also, the water jet has pressures in the order of 16,000 to 35,000 PSIG. This results in the waterjet hitting surface of the paper at speeds in excess of 615 meters/second.

**[0042]** Another aspect to the present invention relates to the trimming station 12 as shown below the web 14 in Figures 2,3 and 5. The trimming station 12 includes a support table 78 over which at least an edge portion 77 of the web 14 travels. The portion of the trimming station 12 located below the web 14 performs a novel function in waterjet cutting. The purpose of the trimming station 12 below the web 14 is to evacuate effluent by-products downwardly away from the point of cutting impingement 52. To accomplish this the trimming station 12 further includes a cutting station 13 mounted on a support table 78. The cutting station 13 has a hardened cutting surface 82. The surface 82 comprises a ceramic shoe mounted raised above the cutting station 13 of support table 78. It is also apparent from the drawings that the cutting station 13 has beveled or sloped edge 79. Sloped edge 79 allows the paper web 14 to run up over the support table 78. The ceramic surface 82 also has bevelled edges and is sufficiently hard to better withstand cutting and wear associated with the waterjet cutting and abrasiveness of coated paper.

**[0043]** The ceramic shoe 82 includes an effluent receiving aperture 84. The ceramic shoe has an undercut or cut out 83 (Figure 5) below the aperture 84 to minimize the amount of land area the jet is striking within the aperture. Because the effluent by-products contained in the waterjet have adhesive characteristics, the smaller the depth of the aperture 84 the less build-up of residues can occur in the aperture resulting in exhausting of the effluent by-products below the web. At the same time the wear resistance of the shoe must be maintained. In the preferred embodiment, it has been found that the depth of this aperture should be in the order of 2 to 4 mm. The axis of the effluent receiving aperture 84 is preferably in alignment with the waterjet axis 48. It should be understood that the aperture could be cone shaped with a conical wall of the aperture lying parallel to the waterjet axis 48.

**[0044]** The cutting station 13 further includes a draft tube 88 connected in fluid flow communication with the effluent receiving aperture 84. The draft tube 88 extends approximately 75 to 100mm into a mixing zone 90. The preferred extension of the draft tube is about 100mm. The mixing zone 90 is connected to exhaust or a negative pressure apparatus 100(Figure 1). Pipe 92 surrounds the draft tube 88 and is spaced from the draft tube 88. An outer passage 94 is located between the pipe 92 and the draft tube 88. Pipe 92 has an air inlet 98 and a water inlet 96. An air control valve 85 controls the volume of air drawn from the environment. Water valve 87 controls flow of water into inlet 96; together the valves 85 and 87 control negative pressure or vacuum in the mixing zone 90. Due to the negative pressure, the water entering through water inlet 96, and air entering through inlet 98 cause the effluent by-products to be drawn through aperture 84 to be mixed in the mixing zone 90. This allows for a dilution of the effluents to facilitate removal from the cutting station. The mixing zone 90 is connected to exhaust 100(Figure 1)

**[0045]** By drawing effluent by-products into the cutting station, the present invention diminishes the amount of fog or potential backsplash which would, otherwise remain below web 14 and cutting table 78 and could result in uneven buildup of by-products effecting function of the edge trimmer.

**[0046]** The aperture 84 at point of impingement 52 is located a distance 110 upstream from the downstream end 122 of the cutting station 13. This distance 110 is about 40mm. By maintaining this distance relatively short below 50mm, there is an insufficient surface length over which the web 14 and trim piece 54 travel thereby minimizing the surface area over which gummy deposits of effluent by-products can buildup creating a ridge of hardened material that can adversely effect the cutting performance of the water jet station. This buildup is the result of effluent by-products or backsplash that remains below the surface of web 14 and are not drawn into aperture 84.

**[0047]** The cutting station 13 in addition to the raised ceramic shoe 82 includes a first raised platform 126 extending downstream of the cutting station 13. The station 13 further includes a lower initially or stepped down second platform 128. The platforms 126 and 128 are at the same height close to the ceramic shoe 82. Platform 128 curves and is offset below platform 126 in the direction of web travel. Platforms 126 and 128 are separated by an elongated slotted aperture 130. The purpose of the platform 126 is to temporarily support the traveling web 14 and the purpose of the second platform 126 is to temporarily support the edge trim piece 54 prior to disposal in the trim chute 56. The raising of the first platform 126 relative to the second platform 128 provides for better separation of the edge trim piece 54 from the coated web 14. The elongated slotted aperture 130 provides an open space between the platforms 126 and 128 over which the wet edges 132 and 134, respectively, of the cut web 14 and edge trim piece 54 are allowed to dry so that effluent by-products do not build up on a surface effecting paper quality and the trimming operation.

**[0048]** While the foregoing description has been made in reference to the drawings and an "on-machine" coating section of a papermaking machine, it should be understood that various aspects of the present invention

may find application in other parts of papermaking machines as would be readily apparent to a man skilled in the art.

## Claims

1. A water jet edge trimming station (12) for trimming an edge (54) of a traveling paper web (14) in a papermaking machine (10), comprising a water jet apparatus (28) supported above said web (14) for directing a water jet (48) towards a point of impingement (52) against said web (14) to cut through said web (14) and form an edge trim piece (54) separate from said web (14), and said water jet (48) forming effluent by-products as it cuts said web (14), a support table (78) positioned below said water jet (48) and over which at least an edge portion (77) of said web (14) travels, said support table (78) includes a cutting station (13),
said cutting station (13) including a hardened cutting surface (82) for withstanding cutting and wear associated with the paper (14) striking said cutting surface (82),
said cutting station (13) including an effluent receiving aperture (84) extending from the cutting surface (82) through the cutting station (13) and positioned directly below the point of impingement (52) of said water jet (48) through which passes said water jet (48) after cutting through said web (14),
an apparatus (100) mounted below the cutting station (13) for creating a negative pressure and surrounding the effluent receiving aperture (84) adapted to draw said water jet (48) and said effluent by-products through said receiving aperture (84) to reduce backsplash of effluent by-products, and
a trim removal chute (56) separate and distinct from said negative pressure apparatus (100), said trim removal chute (56) being positioned adjacent and downstream of said support table (78) for guiding said edge trim piece (54) away from the web (14).

2. The water jet edge trimming station (12) of claim 1 further **characterized by** said support table (78) including a ceramic shoe having said hardened cutting surface (82) and said effluent receiving aperture (84).

3. The water jet edge trimming station (12) of claim 1 or 2 further **characterized by** said negative pressure apparatus (100) including a draft tube (88) extending below the effluent receiving aperture (84).

4. The water jet edge trimming station (12) of any of the claims 1 to 3 further **characterized by** said negative pressure apparatus (100) comprising a vacuum generating device (85, 87) in communication with said draft tube (88).

5. The water jet edge trimming station (12) of claim 3 further **characterized by** said cutting station (13) including a chamber (90) into which said draft tube (88) partially extends to define an outer passage (94) surrounding the draft tube (88), said chamber (90) including a water inlet (96) and an air inlet (98) adjacent the hardened cutting surface (82) which permit the introduction of water and air into the an outer passage (94) surrounding the draft tube (88), said cutting station (13) further including a mixing zone (90) located below the draft tube (88) and the outer passage (94) for mixing the air and water from the outer passage (94) and effluent by-products from said draft tube (88).

6. The water jet edge trimming station (12) of claim 5 further **characterized by** said negative pressure apparatus (100) including a vacuum generating device (85, 87) connected to the lower end of said mixing station to assist in evacuating waste from said mixing zone (90) through an outlet pipe.

7. The water jet edge trimming station (12) of claim 5 further **characterized by** the trim removal chute (56)attached to the outside edge of the support table (78) for guiding said edge trim piece (54) away from the web (14).

8. The water jet edge trimming station (12) of any of the claims 1, 2 or 3 further **characterized by** the cutting station (13) including a draft tube (88) extending from the effluent receiving aperture (84) into a mixing zone (90), the cutting station (13) including a pipe surrounding the draft tube (88) to provide an outer passage (94) surrounding said draft tube (88), said pipe including an air inlet (98) and a water inlet (96), said negative pressure apparatus (100) including valve controllers associated with each of the air and water inlets (98, 96) which regulate flow of the air and water into said mixing zone (90), the air and water flowing into the mixing zone (90) mixing with the effluent by-products from the draft tube (88) to provide a waste that can be evacuated from said mixing zone (90).

9. The water jet edge trimming station (12) of any of the claims 1 to 8 further **characterized by** the water jet (48) being angled relative to an axis (61) extending through the point of impingement (52) and normal to a plane of the web (14).

10. The water jet edge trimming station (12) of claim 9 further **characterized by** the water jet (48) being further angled towards the outside edge of the traveling web (14).

11. The water jet edge trimming station (12) of claim 10 further **characterized by** the effluent receiving ap-

erture (84) having an axis aligned with an axis along which the water jet (48) is emitted.

12. The water jet edge trimming station (12) of claim 1 further **characterized by** the web (14) of paper being coated prior to entering the trimming station (12).

13. The water jet edge trimming station (12) of any of the claims 1 to 3 further **characterized by** the effluent receiving aperture (84) being located a predetermined distance upstream of a downstream end of the cutting station (13) to reduce buildup of effluent by-products on the hardened surface of the cutting station (13) downstream of the effluent receiving aperture (84).

14. The water jet edge trimming station (12) of claim 13 further **characterized by** said predetermined distance being in the range of 5 to 50 mm.

15. The water jet edge trimming station (12) of any of the claims 1 to 8 further **characterized by** said effluent receiving aperture (84) having a predetermined depth permitting an effective vacuum to be drawn through said effluent receiving aperture (84) to effectively accept effluent by-products through the aperture diminishing the volume of effluent by-products available for backsplash.

16. The water jet edge trimming station (12) of any of the claims 1 to 8 and 15 further **characterized by** said hardened surface (82) including a cut out (83) below the hardened surface (82) adjacent the effluent receiving aperture (84) to control the predetermined depth.

17. The water jet edge trimming station (12) of claim 15 further **characterized by** said predetermined depth being between about 2 to 4 mm.

18. The water jet edge trimming station (12) of any of the claims 1 to 8 further **characterized by** said support table (78) including an elongated slotted aperture (130) extending from the cutting station (13) in the downstream direction of travel of said web (14) over which edges of the web (14) and the edge trim piece (54) travel unsupported.

19. The water jet edge trimming station (12) of any of the claims 1 to 8 and 18 further **characterized by** said support table (78) including a first platform (126) extending around and downstream from the cutting station (13) for supporting the traveling web (14) and a second platform (128) extending downstream from said cutting station (13), said second platform (128) starting at the same height as the first platform (126) and curving downwardly below the first platform (126) in the direction of web (14) travel, said second platform (128) supporting said edge trim piece (54) separated from said web (14), and said first platform (126) being raised and laterally separated from said second platform (128) by said elongated slotted aperture (130).

20. The water jet edge trimming station (12) of any of the claims 1 to 8 and 18 further **characterized by** said hardened material of said cutting station (13) being supported in a raised manner above said support table (78), said support table (78) including a first platform (126) extending downstream from the cutting station (13) below the raised hardened material for supporting the traveling web (14) and a second platform (128) extending downstream from said cutting station (13) and positioned lower than the first platform (126), said second platform (128) supporting said edge trim piece (54) separated from said web (14), and said first platform (126) being raised and laterally separated from said second platform (128) by said elongated slotted aperture.

21. The water jet edge trimming station (12) of claim 1 wherein said station comprising the water jet apparatus (28) having a nozzle (46) supported in spaced relation from the web (14) plane for emitting the water jet (48) along a water jet (48) axis towards the point of impingement (52) against said web (14) and further **characterized by** said water jet (48) axis having a first orientation offset by a first predetermined angle (62) relative to a normal axis (61) extending at a right angle out of the web (14) plane from said point of impingement (52) such that the first orientation of said water jet (48) directs the water jet (48) in a first direction relative to web (14) travel to reduce backsplash of effluent by-products onto said nozzle, and said water jet axis having a second orientation rotated by a second predetermined angle (58) in the range of 5° to 135° about said normal axis (61) from a line extending parallel to the direction of web (14) travel passing through the point of impingement (52), whereby said water jet (48) is directed towards the edge trim piece (54) causing effluent by-products to move towards said edge trim piece (54) and away from said web (14) to reduce backsplash onto said nozzle and said web (14).

22. The water jet edge trimmer of claim 21 further **characterized by** said first direction being one direction selected from the group consisting of a downstream direction of web (14) travel and an upstream direction of web (14) travel.

23. The water jet edge trimming station (12) of claim 21 further **characterized by** the first predetermined angle (62) being in the range of 5° to 45°.

24. The water jet edge trimming station (12) of claim 21 further **characterized by** the first predetermined angle (62) being about 22°.

25. The water jet edge trimming station (12) of claim 23 further **characterized by** said second predetermined angle (58) being in the range of 5° to 89° and the water jet (48) is directed in a downstream direction.

26. The water jet edge trimming station (12) of claim 23 further **characterized by** the second predetermined angle (58) being in the range of 91° to 135° and the water jet (48) is directed in an upstream direction.

27. The water jet edge trimming station (12) of claim 24 further **characterized by** the second predetermined angle (58) being about 30°.

28. The water jet edge trimming station (12) of claim 21 further **characterized by** the nozzle (46) being maintained within a predetermined distance from the traveling web (14) to maintain a laminar jet of water to cut said web (14).

29. The water jet edge trimming station (12) of claim 28 further **characterized by** said predetermined distance being about 12 mm from said web (14).

30. The water jet trimming station (12) of claim 21 further **characterized by** an auxiliary air nozzle (75) positioned in the vicinity of the water jet (48) for directing an air stream downstream and towards an edge of the traveling web (14) to move the edge trim piece (54) away from the traveling web (14) and to further direct effluent by-products away from the traveling web (14) and water jet nozzle (46).

**Patentansprüche**

1. Wasserstrahl-Randbeschneidestation (12) zum Beschneiden eines Randes (54) einer wandernden Papierbahn (14) in einer Papierherstellungsmaschine (10) die Folgendes aufweist: eine Wasserstrahlvorrichtung (28), die über der Bahn (14) angeordnet ist, um einen Wasserstrahl (48) in Richtung eines Auftreffpunktes (52) gegen die Bahn (14) zu richten, um diese Bahn (14) zu durchschneiden und einen von der Bahn (14) getrennten Randstreifen(54) zu bilden, wobei der Wasserstrahl (48) während des Schneidens der Bahn (14) Abwassernebenprodukte bildet,
einen Auflagetisch (78), der unter dem Wasserstrahl (48) angeordnet ist und über den mindestens ein Randabschnitt (77) der Bahn (14) wandert, wobei der Auflagetisch (78) eine Schneidestation (13) enthält, wobei die Schneidestation (13) eine gehärtete Schneidoberfläche (82) enthält, um dem Schneiden und Verschleiß in Zusammenhang mit dem auf die Schneidoberfläche (82) schlagenden Papier (14) standzuhalten, wobei die Schneidestation (13) eine Abwasseraufnahmeöffnung (84) enthält, die sich von der Schneidoberfläche (82) durch die Schneidestation (13) erstreckt und direkt unter dem Auftreffpunkt (52) des Wasserstrahls (48) angeordnet ist, die der Wasserstrahl (48) nach dem Durchschneiden der Bahn (14) passiert,
eine unter der Schneidestation (13) angeordnete Vorrichtung (100) zum Erzeugen eines Unterdrucks, die die Abwasseraufnahmeöffnung (84) umgibt und so ausgeführt ist, dass sie den Wasserstrahl (48) und die Abwassernebenprodukte durch die Aufnahmeöffnung (84) saugt, um das Zurückspritzen der Abwassernebenprodukte zu verringern, und einen Schacht (56) zum Entfernen des Randstreifens, der getrennt und verschieden von der Unterdruckvorrichtung (100) ist, wobei der Schacht (56) zum Entfernen des Randstreifens neben und nach dem Auflagetisch (78) angeordnet ist, um den Randstreifen (54) von der Bahn (14) weg zu führen.

2. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 1, des Weiteren **gekennzeichnet durch** den Auflagetisch (78), der einen Keramikschuh mit der gehärteten Schneidoberfläche (82) und der Abwasseraufnahmeöffnung (84) enthält.

3. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 1 oder 2, des Weiteren **gekennzeichnet durch** die Unterdruckvorrichtung (100) mit einem Saugrohr (88), das sich unter der Abwasseraufnahmeöffnung (84) erstreckt.

4. Wasserstrahl-Randbeschneidestation (12) nach einem der Ansprüche 1 bis 3, des Weiteren **gekennzeichnet durch** die Unterdruckvorrichtung (100), die ein Vakuumgeneratorgerät (85, 87) aufweist, das mit dem Saugrohr (88) in Verbindung steht.

5. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 3, des Weiteren **gekennzeichnet durch** die Schneidestation (13) mit einer Kammer (90), in die sich das Saugrohr (88) teilweise erstreckt, um einen das Saugrohr (88) umgebenden äußeren Kanal (94) zu bilden, wobei die Kammer (90) einen Wassereinlass (96) und einen Lufteinlass (98) neben der gehärteten Schneidoberfläche (82) enthält, die die Einführung von Wasser und Luft in den das Saugrohr (88) umgebenden äußeren Kanal (94) gestatten, wobei die Schneidestation (13) des Weiteren eine unter dem Saugrohr (88) und dem äußeren Kanal (94) angeordnete Mischzone (90) zum Mischen der Luft und des Wasser aus dem äußeren

Kanal (94) und der Abwassernebenprodukte aus dem Saugrohr (88) enthält.

6. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 5, des Weiteren **gekennzeichnet durch** die Unterdruckvorrichtung (100), die ein Vakuumgeneratorgerät (85, 87) enthält, das mit dem unteren Ende der Mischstation verbunden ist, um die Evakuierung von Abfallstoffen aus der Mischzone (90) **durch** ein Auslaßrohr zu unterstützen.

7. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 5, des Weiteren **gekennzeichnet durch** den Schacht (56) zum Entfernen des Randstreifens, der an der Außenkante des Auflagetischs (78) angebracht ist, um den Randstreifen (54) von der Bahn (14) weg zu führen.

8. Wasserstrahl-Randbeschneidestation (12) nach einem der Ansprüche 1, 2 oder 3, des Weiteren **gekennzeichnet durch** die Schneidestation (13), die ein Saugrohr (88) enthält, das sich von der Abwasseraufnahmeöffnung (84) in eine Mischzone (90) erstreckt, wobei die Schneidestation (13) ein das Saugrohr (88) umgebendes Rohr enthält, um einen das Saugrohr (88) umgebenden äußeren Kanal (94) zu bilden, wobei dieses Rohr einen Lufteinlass (98) und einen Wassereinlass (96) enthält, wobei die Unterdruckvorrichtung (100) zu jedem der Luft- und Wassereinlässe (98, 96) gehörige Ventilregler enthält, die die Luft- und Wasserströmung in die Mischzone (90) regeln, wobei die Luft und das Wasser, die in die Mischzone (90) strömen, sich mit den Abwassernebenprodukten aus dem Saugrohr (88) mischen, um einen Abfallstoff zu bilden, der aus der Mischzone (90) evakuiert werden kann.

9. Wasserstrahl-Randbeschneidestation (12) nach einem der Ansprüche 1 bis 8, des Weiteren **gekennzeichnet durch** den Wasserstrahl (48), der relativ zu einer **durch** den Auftreffpunkt (52) verlaufenden Achse (61) unter einem Winkel und zur Ebene der Bahn (14) senkrecht verläuft.

10. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 9, des Weiteren **gekennzeichnet durch** den Wasserstrahl (48), der außerdem unter einem Winkel zur Außenkante der wandernden Bahn (14) geneigt verläuft.

11. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 10, des Weiteren **gekennzeichnet durch** die Abwasseraufnahmeöffnung (84) mit einer Achse, die auf eine Achse ausgerichtet ist, entlang der der Wasserstrahl (48) austritt.

12. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 1, des Weiteren **dadurch gekennzeichnet, dass** die Bahn (14) aus Papier vor dem Eintritt in die Beschneidestation (12) beschichtet wird.

13. Wasserstrahl-Randbeschneidestation (12) nach einem der Ansprüche 1 bis 3, des Weiteren **gekennzeichnet durch** die Abwasseraufnahmeöffnung (84), die in einem vorgegebenen Abstand vor einem stromabwärtigen Ende der Schneidestation (13) angeordnet ist, um die Ansammlung von Abwassernebenprodukten auf der gehärteten Oberfläche der Schneidestation (13) nach der Abwasseraufnahmeöffnung (84) zu verringern.

14. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 13, des Weiteren **dadurch gekennzeichnet, dass** der vorgegebene Abstand im Bereich von 5 bis 50 mm liegt.

15. Wasserstrahl-Randbeschneidestation (12) nach einem der Ansprüche 1 bis 8, des Weiteren **gekennzeichnet durch** die Abwasseraufnahmeöffnung (84) mit einer vorgegebenen Tiefe, die es gestattet, ein wirksames Vakuum **durch** die Abwasseraufnahmeöffnung (84) anzulegen, um Abwassernebenprodukte wirksam **durch** die Öffnung aufzunehmen, wodurch das zum Zurückspritzen zur Verfügung stehende Volumen der Abwassernebenprodukte verringert wird.

16. Wasserstrahl-Randbeschneidestation (12) nach einem der Ansprüche 1 bis 8 und des Weiteren **gekennzeichnet durch** die gehärtete Oberfläche (82), die einen Ausschnitt (83) unter der gehärteten Oberfläche (82) neben der Abwasseraufnahmeöffnung (84) enthält, um die vorgegebene Tiefe zu regeln.

17. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 15, des Weiteren **dadurch gekennzeichnet, dass** die vorgegebene Tiefe zwischen ca. 2 und 4 mm liegt.

18. Wasserstrahl-Randbeschneidestation (12) nach einem der Ansprüche 1 bis 8, des Weiteren **gekennzeichnet durch** den Auflagetisch (78) mit einer länglichen geschlitzten Öffnung (130), die sich von der Schneidestation (13) in stromabwärtiger Richtung der Wanderung des Bandes (14) erstreckt, über die die Ränder der Bahn (14) und der Randstreifen (54) nicht aufliegend wandern.

19. Wasserstrahl-Randbeschneidestation (12) nach einem der Ansprüche 1 bis 8 und 18, des Weiteren **gekennzeichnet durch** den Auflagetisch (78), der eine erste Plattform (126) enthält, die sich um die und stromabwärts von der Schneidestation (13) erstreckt, um die wandernde Bahn (14) zu tragen, und eine zweite Plattform (128), die sich stromabwärts

von der Schneidestation (13) erstreckt, wobei die zweite Plattform (128) in der gleichen Höhe wie die erste Plattform (126) beginnt und sich nach unten unter die erste Plattform (126) in Wanderungsrichtung der Bahn (14) krümmt, wobei die zweite Plattform (128) den von der Bahn (14) getrennten Randstreifen (54) trägt und die erste Plattform (126) angehoben und seitlich von der zweiten Plattform (128) **durch** die längliche geschlitzte Öffnung (130) getrennt ist.

20. Wasserstrahl-Randbeschneidestation (12) nach einem der Ansprüche 1 bis 8 und 18, des Weiteren **gekennzeichnet durch** das gehärtete Material der Schneidestation (13), das in einer angehobenen Weise über dem Auflagetisch (78) angeordnet ist, wobei der Auflagetisch (78) eine erste Plattform (126) enthält, die sich stromabwärts von der Schneidestation (13) unter das angehobene gehärtete Material erstreckt, um die wandernde Bahn (14) zu tragen, und eine zweite Plattform (128), die sich stromabwärts von der Schneidestation (13) erstreckt und niedriger angeordnet ist als die erste Plattform (126), wobei die den Randstreifen (54) tragende zweite Plattform (128) von der Bahn (14) getrennt und die erste Plattform (126) angehoben und seitlich von der zweiten Plattform (128) **durch** die längliche geschlitzte Öffnung (130) getrennt ist.

21. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 1, bei der die Station mit der Wasserstrahlvorrichtung (28) eine Düse (46) hat, die in einer beabstandeten Beziehung zur Ebene der Bahn (14) angeordnet ist, um den Wasserstrahl (48) entlang einer Achse des Wasserstrahls (48) in Richtung des Auftreffpunkts (52) gegen die Bahn (14) auszusenden, und des Weiteren **gekennzeichnet durch** die Achse des Wasserstrahls (48), die eine erste Ausrichtung hat, die um einen ersten vorgegebenen Winkel (62) relativ zu einer senkrechten Achse (61) versetzt ist, die sich im rechten Winkel aus der Ebene der Bahn (14) vom Auftreffpunkt (52) auf eine solche Weise erstreckt, dass die erste Ausrichtung des Wasserstrahls (48) den Wasserstrahl (48) in eine erste Richtung relativ zur Wanderung der Bahn (14) lenkt, um ein Zurückspritzen der Abwassernebenprodukte auf die Düse zu verringern, und die Achse des Wasserstrahls, die eine zweite Ausrichtung hat, die um einen zweiten vorgegebenen Winkel (58) im Bereich von 5° bis 135° um die senkrechte Achse (61) von einer parallel zur Richtung der Wanderung der Bahn (14) **durch** den Auftreffpunkt (52) verlaufenden Linie gedreht ist, wodurch der Wasserstrahl (48) in Richtung des Randstreifens (54) gelenkt wird, wodurch Abwassernebenprodukte veranlasst werden, sich in Richtung des Randstreifens (54) und weg von der Bahn (14) zu bewegen, um ein Zurückspritzen auf die Düse und die Bahn (14) zu verringern.

22. Wasserstrahl-Randbeschneider nach Anspruch 21, des Weiteren **dadurch gekennzeichnet, dass** die erste Richtung eine Richtung ist, die aus einer Gruppe bestehend aus einer stromabwärtigen Richtung der Wanderung der Bahn (14) und einer stromaufwärtigen Richtung der Wanderung der Bahn (14) gewählt wird.

23. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 21, des Weiteren **dadurch gekennzeichnet, dass** der erste vorgegebene Winkel (62) im Bereich von 5° bis 45° liegt.

24. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 21, des Weiteren **dadurch gekennzeichnet, dass** der erste vorgegebene Winkel (62) etwa 22° beträgt.

25. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 23, des Weiteren **dadurch gekennzeichnet, dass** der zweite vorgegebene Winkel (58) im Bereich von 5° bis 89° liegt und der Wasserstrahl (48) in stromabwärtiger Richtung gerichtet ist.

26. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 23, des Weiteren **dadurch gekennzeichnet, dass** der zweite vorgegebene Winkel (58) im Bereich von 91° bis 135° liegt und der Wasserstrahl (48) in stromaufwärtiger Richtung gerichtet ist.

27. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 24, des Weiteren **dadurch gekennzeichnet, dass** der zweite vorgegebene Winkel (58) ca. 30° beträgt.

28. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 21, des Weiteren **dadurch gekennzeichnet, dass** die Düse (46) innerhalb eines vorgegebenen Abstands von der wandernden Bahn (14) gehalten wird, um einen laminaren Wasserstrahl zum Schneiden dieser Bahn (14) aufrechtzuerhalten.

29. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 28, des Weiteren **dadurch gekennzeichnet, dass** der vorgegebene Abstand etwa 12 mm zur Bahn (14) beträgt.

30. Wasserstrahl-Randbeschneidestation (12) nach Anspruch 21, des Weiteren durch eine Hilfsluftdüse (75) **gekennzeichnet**, die in der Nachbarschaft des Wasserstrahls (48) angeordnet ist, um einen Luftstrom nach unten und in Richtung des Randes der wandernden Bahn (14) zu richten, damit der Rand-

streifen (54) von der wandernden Bahn (14) weg bewegt wird, und um des Weiteren Abwasserne-benprodukte von der wandernden Bahn (14) und der Düse (46) des Wasserstrahls weg zu bewegen.

**Revendications**

1. Dispositif de rognage de bord à jet d'eau (12) destiné à rogner un bord (54) d'une bande de papier (14) en déplacement dans une machine de fabrication de papier (10), comprenant un dispositif à jet d'eau (28) supporté au-dessus de ladite bande (14) afin de diriger un jet d'eau (48) vers un point d'impact (52) contre ladite bande (14) de manière à découper ladite bande (14) et à former une chute de bord (54) séparée de ladite bande (14), ledit jet d'eau (48) formant des sous-produits d'effluent lorsqu'il coupe ladite bande (14), une table de support (78) positionnée au-dessous dudit jet d'eau (48) et au-dessus de laquelle au moins une partie de bord (77) de ladite bande (14) se déplace, ladite table de support (78) comportant un dispositif de découpe (13),

ledit dispositif de découpe (13) comprenant une surface de coupe durcie (82) afin de résister à la découpe et à l'usure associées au papier (14) frappant ladite surface de coupe (82),
ledit dispositif de découpe (13) comprenant une ouverture de réception d'effluent (84) s'étendant à partir de la surface de coupe (82) à travers le dispositif de découpe (13) et positionnée directement au-dessous du point d'impact (52) dudit jet d'eau (48) par laquelle passe ledit jet d'eau (48) après avoir découpé à travers ladite bande (14),

un dispositif (100) monté au-dessous du dispositif de découpe (13) afin de créer une dépression et entourant l'ouverture de réception d'effluent (84), adapté pour aspirer ledit jet d'eau (48) et lesdits sous-produits d'effluent à travers ladite ouverture de réception (84) de manière à réduire les éclaboussures de sous-produits d'effluent, et

une goulotte d'élimination de chute (56) séparée et distincte par rapport audit dispositif de mise en dépression (100), ladite goulotte d'élimination de chute (56) étant positionnée de manière adjacente et en aval de ladite table de support (78) afin de guider ladite chute de bord (54) à l'écart de la bande (14).

2. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 1, **caractérisé, en outre, par le fait que** ladite table de support (78) comprend un sabot en céramique présentant ladite surface de coupe durcie (82) et ladite ouverture de réception d'effluent (84).

3. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 1 ou 2, **caractérisé, en outre, par le fait que** ledit dispositif de mise en dépression (100) comprend un tube d'aspiration (88) s'étendant au-dessous de l'ouverture de réception d'effluent (84).

4. Dispositif de rognage de bord à jet d'eau (12) selon l'une quelconque des revendications 1 à 3, **caractérisé, en outre, par le fait que** ledit dispositif de mise en dépression (100) comprend un dispositif de production de vide (85, 87) en communication avec ledit tube d'aspiration (88).

5. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 3, **caractérisé, en outre, par le fait que** ledit dispositif de découpe (13) comprend une chambre (90) dans laquelle ledit tube d'aspiration (88) s'étend partiellement afin de définir un passage externe (94) entourant ledit tube d'aspiration (88), ladite chambre (90) comprenant une entrée d'eau (96) et une entrée d'air (98) de manière adjacente à la surface de coupe durcie (82) qui permettent l'introduction d'eau et d'air dans ledit passage externe (94) entourant le tube d'aspiration (88), ledit dispositif de découpe (13) comprenant, en outre, une zone de mélange (90) située au-dessous du tube d'aspiration (88) et du passage externe (94) afin de mélanger l'air et l'eau sortant du passage externe (94) et les sous-produits d'effluent à partir dudit tube d'aspiration (88).

6. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 5, **caractérisé, en outre, par le fait que** ledit dispositif de mise en dépression (100) comprend un dispositif de production de vide (85, 87) raccordé à l'extrémité inférieure dudit dispositif de mélange afin de faciliter l'évacuation de déchets à partir de ladite zone de mélange (90) à travers un conduit de sortie.

7. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 5, **caractérisé, en outre, par le fait que** ladite goulotte d'élimination de chute (56) est fixée sur le bord externe de la table de support (78) afin de guider ladite chute de bord (54) à l'écart de la bande (14).

8. Dispositif de rognage de bord à jet d'eau (12) selon l'une quelconque des revendications 1, 2 ou 3, **caractérisé, en outre, par le fait que** le dispositif de découpe (13) comprend un tube d'aspiration (88) s'étendant à partir de l'ouverture de réception (84) dans une zone de mélange (90), le dispositif de découpe (13) comprend un conduit entourant le tube d'aspiration (88) afin de former un passage externe (94) entourant ledit tube d'aspiration (88), ledit conduit comprend une entrée d'air (98) et une entrée d'eau (96), ledit dispositif de mise en dépression

(100) comprend des régulateurs à vanne associés à chacune desdites entrées d'air et d'eau (98, 96) qui régulent le débit de l'air et de l'eau dans ladite zone de mélange (90), l'air et l'eau circulant dans la zone de mélange (90) se mélangeant avec les sous-produits d'effluent sortant du tube d'aspiration (88) afin de former un déchet qui peut être évacué à hors de ladite zone de mélange (90).

9. Dispositif de rognage de bord à jet d'eau (12) selon l'une quelconque des revendications 1 à 8, **caractérisé, en outre, par le fait que** le jet d'eau (48) est incliné par rapport à un axe (61) passant par le point d'impact (52) et normal à un plan de la bande (14).

10. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 9, **caractérisé, en outre, par le fait que** le jet d'eau (48) est, en outre, incliné vers le bord externe de la bande (14) en déplacement.

11. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 10, **caractérisé, en outre, par le fait que** l'ouverture de réception d'effluent (84) présente un axe aligné avec un axe le long duquel le jet d'eau (48) est émis.

12. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 1, **caractérisé, en outre, par le fait que** la bande (14) de papier reçoit un revêtement avant d'entrer dans le dispositif de rognage (12).

13. Dispositif de rognage de bord à jet d'eau (12) selon l'une quelconque des revendications 1 à 3, **caractérisé, en outre, par le fait que** l'ouverture de réception d'effluent (84) est située à une distance prédéterminée en amont d'une extrémité aval du dispositif de découpe (13) afin de réduire l'accumulation de sous-produits d'effluent sur la surface durcie du dispositif de découpe (13) en aval de l'ouverture de réception d'effluent (84).

14. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 13, **caractérisé, en outre, par le fait que** ladite distance prédéterminée est comprise dans la plage de 5 à 50 mm.

15. Dispositif de rognage de bord à jet d'eau (12) selon l'une quelconque des revendications 1 à 8, **caractérisé, en outre, par le fait que** ladite ouverture de réception d'effluent (84) présente une profondeur prédéterminée permettant une mise en dépression efficace à travers ladite ouverture de réception d'effluent (84) afin d'accepter de manière efficace des sous-produits d'effluent à travers l'ouverture, réduisant le volume de sous-produits d'effluent pouvant créer des éclaboussures.

16. Dispositif de rognage de bord à jet d'eau (12) selon l'une quelconque des revendications 1 à 8 et 15, **caractérisé, en outre, par le fait que** ladite surface durcie (82) comprend une découpe (83) au-dessous de la surface durcie (82), de manière adjacente à l'ouverture de réception d'effluent (84), afin de commander la profondeur prédéterminée.

17. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 15, **caractérisé, en outre, par le fait que** ladite profondeur prédéterminée est comprise entre 2 et 4 mm.

18. Dispositif de rognage de bord à jet d'eau (12) selon l'une quelconque des revendications 1 à 8, **caractérisé, en outre, par le fait que** ladite table de support (78) comprend une ouverture en fente allongée (130) s'étendant à partir du dispositif de découpe (13) dans la direction aval du trajet de ladite bande (14) au-dessus de laquelle les bords de la bande (14) et la chute de bord (54) se déplacent de manière non supportée.

19. Dispositif de rognage de bord à jet d'eau (12) selon l'une quelconque des revendications 1 à 8 et 18, **caractérisé, en outre, par le fait que** ladite table de support (78) comprend une première plate-forme (126) s'étendant autour du dispositif de découpe (13), et en aval de celui-ci, afin de supporter la bande (14) en déplacement et une seconde plate-forme (128) s'étendant en aval par rapport audit dispositif de découpe (13), ladite seconde plate-forme (128) commençant à la même hauteur que la première plate-forme (126) et s'incurvant vers le bas au-dessous de la première plate-forme (126) dans la direction du déplacement de la bande (14), ladite seconde plate-forme (128) supportant ladite chute de bord (54) séparée de ladite bande (14), et ladite première plate-forme (126) étant surélevée et séparée latéralement par rapport à ladite seconde plate-forme (128) par ladite ouverture en fente allongée (130).

20. Dispositif de rognage de bord à jet d'eau (12) selon l'une quelconque des revendications 1 à 8 et 18, **caractérisé, en outre, par le fait que** ledit matériau durci dudit dispositif de découpe (13) est supporté d'une manière surélevée au-dessus de ladite table de support (78), ladite table de support (78) comprenant une première plate-forme (126) s'étendant en aval par rapport au dispositif de découpe (13) au-dessous du matériau durci surélevé afin de supporter la bande (14) en déplacement et une seconde plate-forme (128) s'étendant en aval par rapport audit dispositif de découpe (13) et positionnée à un niveau inférieur à celui de la première plate-forme (126), ladite seconde plate-forme (128) supportant ladite chute de bord (54) séparée de ladite bande

(14), et ladite première plate-forme (126) étant surélevée et séparée latéralement par rapport à ladite seconde plate-forme (128) par ladite ouverture en fente allongée.

21. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 1, dans lequel ledit dispositif comprend le dispositif à jet d'eau (28) présentant un injecteur (46) supporté en relation espacée par rapport au plan de la bande (14) afin d'émettre le jet d'eau (48) le long d'un axe du jet d'eau (48) orienté vers le point d'impact (52) contre ladite bande (14) et est, en outre, **caractérisé par le fait que:**

ledit axe du jet d'eau (48) présente une première orientation décalée d'un premier angle prédéterminé (62) par rapport à un axe normal (61) s'étendant à angle droit du plan de la bande (14) à partir dudit point d'impact (52) de telle sorte que la première orientation dudit jet d'eau (48) dirige le jet d'eau (48) dans une première direction par rapport au trajet de la bande (14) afin de réduire les éclaboussures de sous-produits d'effluent sur ledit injecteur, et
ledit axe de jet d'eau présente une seconde orientation tournée d'un second angle prédéterminé (58) dans la plage de 5° à 135° autour dudit axe normal (61) par rapport à une ligne s'étendant parallèlement à la direction du trajet de la boude (14) passant par le point d'impact (52), de telle sorte que ledit jet d'eau (48) est dirigé vers la chute de bord (54) provoquant le déplacement des sous-produits d'effluent vers ladite chute de bord (54) et à l'écart de ladite bande (14) afin de réduire les éclaboussures sur ledit injecteur et ladite bande (14).

22. Dispositif de réglage de bord à jet d'eau selon la revendication 21, **caractérisé, en outre, par le fait que** ladite première direction est une direction sélectionnée à partir du groupe constitué par une direction vers l'aval du trajet de la bande (14) et une direction vers l'amont du trajet de la bande (14).

23. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 21, **caractérisé, en outre, par le fait que** le premier angle prédéterminé (62) est compris dans la plage de 5° à 45°.

24. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 21, **caractérisé, en outre, par le fait que** ledit premier angle prédéterminé (62) est égal à 22° environ.

25. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 23, **caractérisé, en outre, par le fait que** ledit second angle prédéterminé (58) est compris dans la plage de 5° à 89° et le jet d'eau (48) est dirigé vers l'aval.

26. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 23, **caractérisé, en outre, par le fait que** ledit second angle prédéberminé (58) est compris dans la plage de 91° à 135° et le jet d'eau (48) est dirigé vers l'amont.

27. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 24, **caractérisé, en outre, par le fait que** le second angle prédéterminé (58) est égal à 30° environ.

28. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 21, **caractérisé, en outre, par le fait que** l'injecteur (46) est maintenu à une distance prédéterminée par rapport à la bande (14) en déplacement afin de maintenir un jet d'eau laminaire de manière à couper ladite bande (14).

29. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 28, **caractérisé, en outre, par le fait que** ladite distance prédéterminée est égale à 12 mm environ par rapport à ladite bande (14).

30. Dispositif de rognage de bord à jet d'eau (12) selon la revendication 21, **caractérisé, en outre, par** un injecteur d'air auxiliaire (75) positionné à proximité du jet d'eau (48) afin de diriger un courant d'air vers l'aval et vers un bord de la bande (14) en déplacement afin de déplacer la chute de bord (54) à l'écart de la bande (14) en déplacement et, en outre, afin d'orienter les sous-produits d'effluent à l'écart de la bande (14) en déplacement et de l'injecteur (46) de jet d'eau.

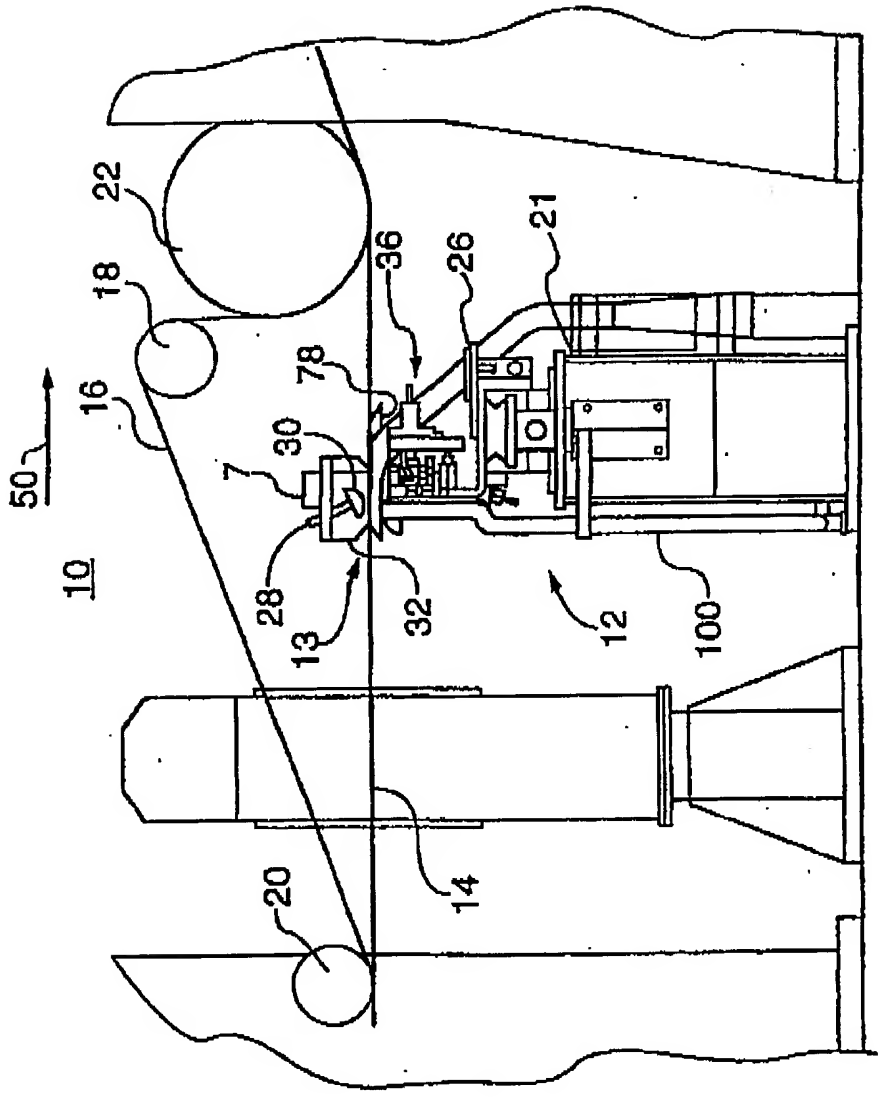
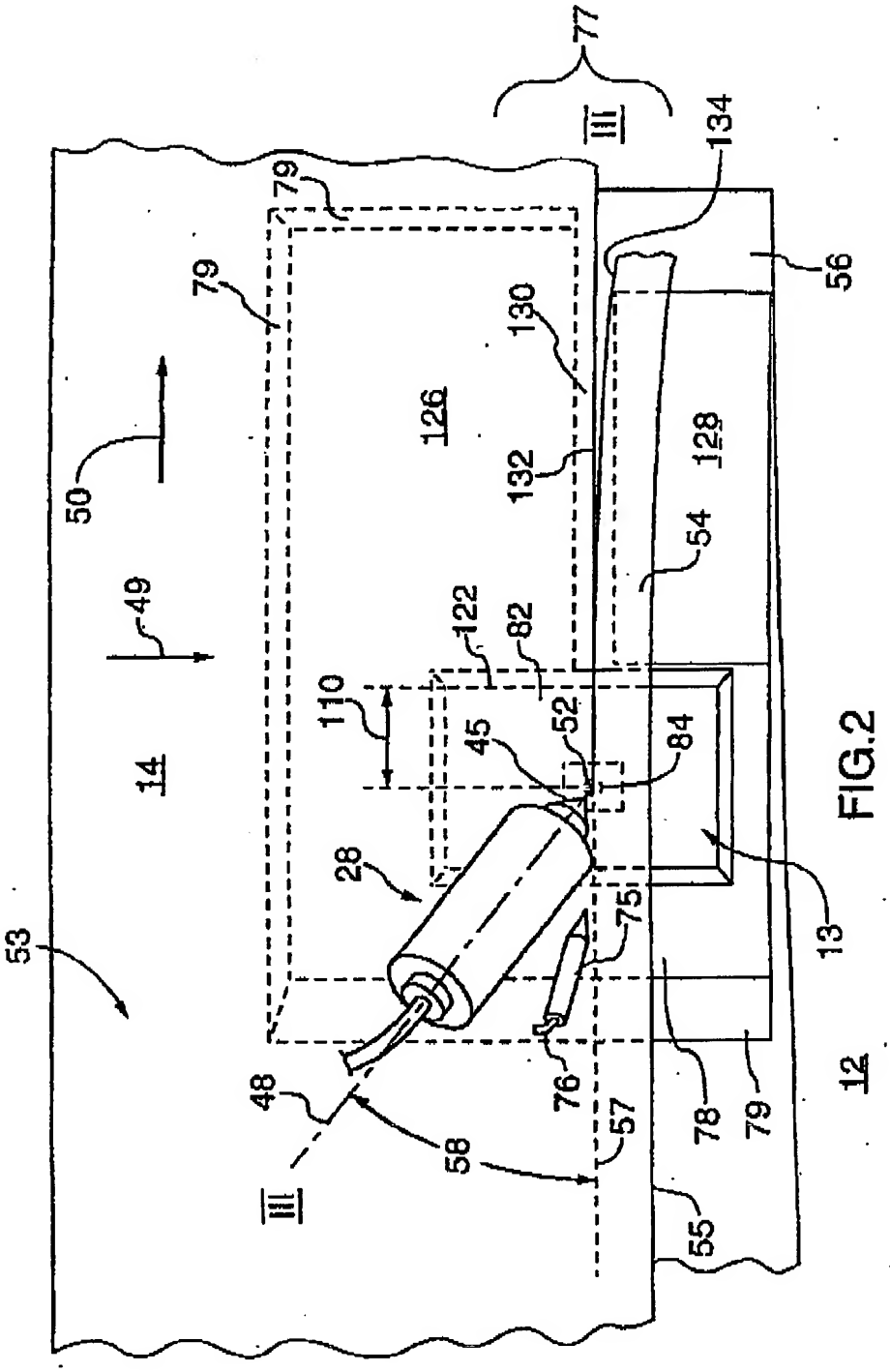



FIG.1


77
III
134
79
56
130
126
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132
54
50
49
122
82
110
52
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84
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28
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75
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48
76
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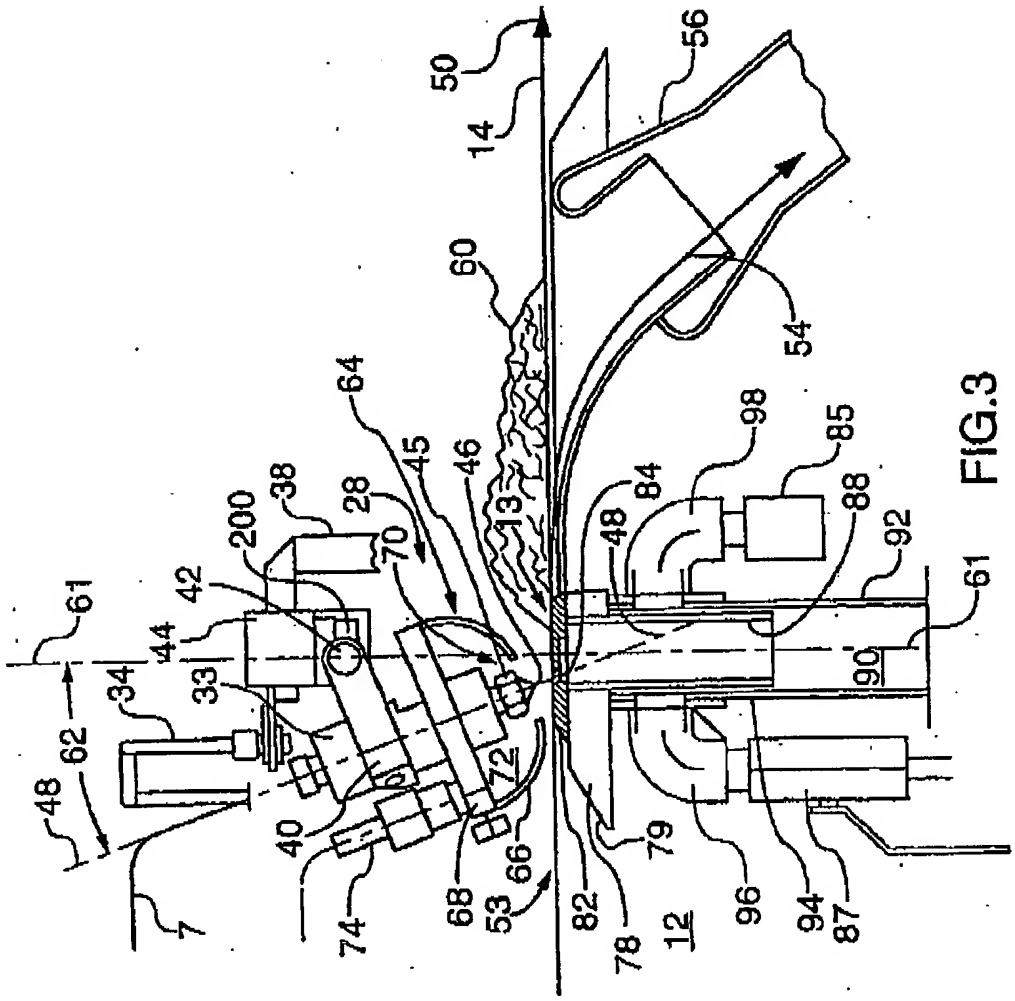
79
12
58
III
55

FIG.2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56
60
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200
70
42
44
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34
33
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40
74
68
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12
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96
94
87
48
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61
90

FIG.3

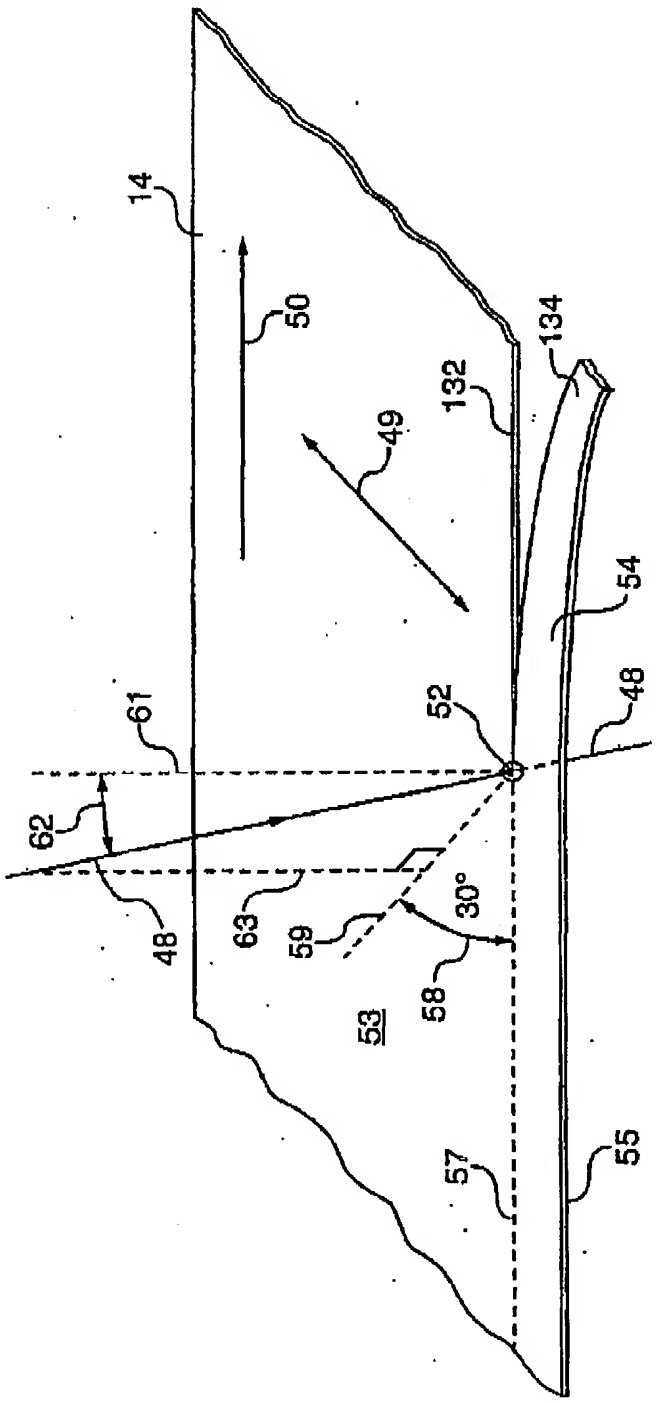
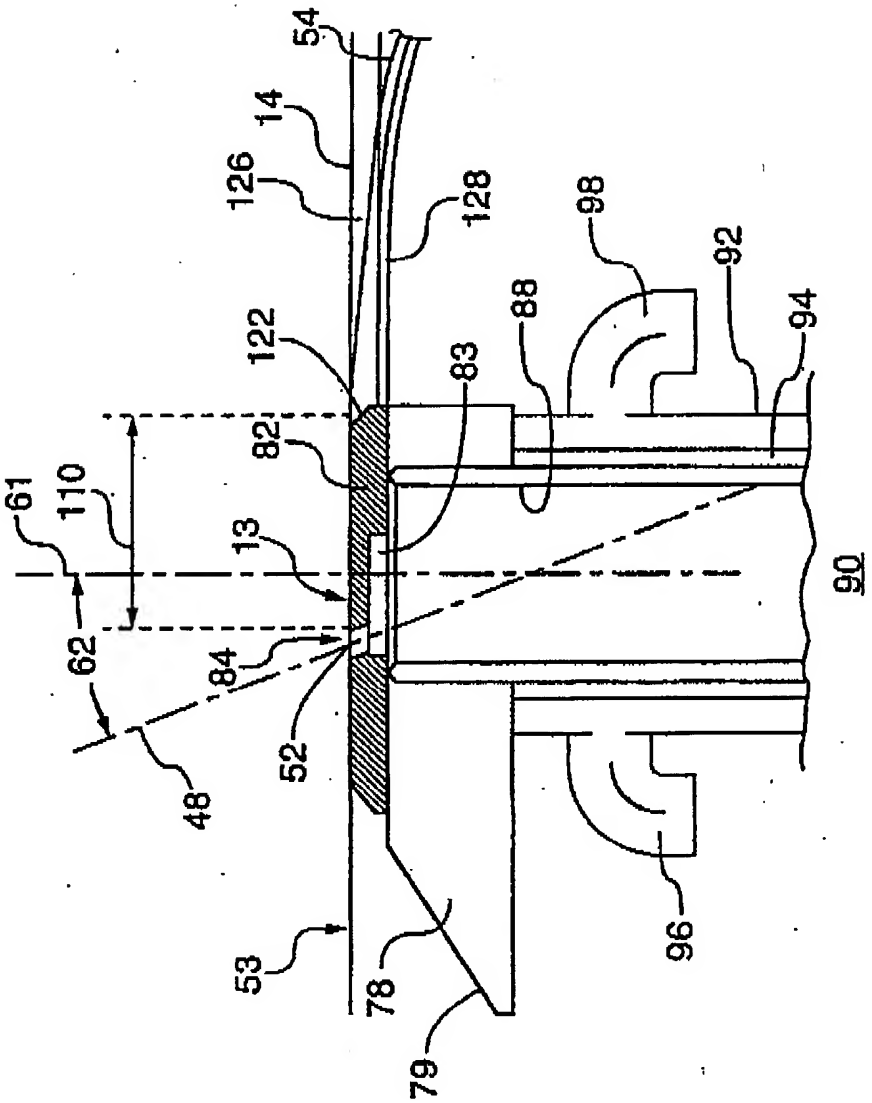



FIG.4


54
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128
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96

FIG.5